

Eco Char	Vital Sign Category	Monitoring Objectives	VS Id#	Vital Sign	Monitoring Question(s)	Monitoring Method	Metrics	Vital Sign Rank (0-5)	Comments / Notes
Physical / Chemical Conditions	Soil, Water, & Nutrient Dynamics	Monitor trends in surface water flow regimes	P17	Flowing surface water hydrology	What are usual rates & range of flow? What is timing & magnitude of floods or droughts? Is erosion occurring, or are flow channels changing?	gages, sampling at permanent sites	erosion, discharge / recharge, diversion patterns, flood timing / magnitude, withdrawal & consumption rates, stream cross-section, stream discharge, stream gradient	2.7	
		Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution	P18	Wetlands (incl. anchialine pools) hydrology	What are freshwater/saltwater recharge rates? What is habitat extent? What are temporal trends in recharge rates and habitat extent?	measure salinity, residence time, mapping	erosion, flood timing/magnitude, flow, parent material/geomorphology, plant cover/species present, pool size, depth & salinity, rainfall, sediment loads, stream cross-section, stream discharge, stream gradient	3.2	
		Monitor biological invertebrate communities	P33	Surface Water Quality - macroinvertebrates	What are community dynamics of benthic freshwater communities?	benthic community composition of standard sampling units	diversity, species richness, indicator species, recruitment	2.6	
	Freshwater Ecosystems	Producers	F1	Community dynamics of primary producers	What species & groups are present? What are normal rates of productivity? Where are algal blooms present?	periodic benthic sampling	abundance, distribution, demographics	2.5	
		Community	F2	Aquatic and Riparian Species (vertebrate and invertebrate) Biodiversity	Are there long-term changes in selected aquatic native communities?	population surveys, transects	Abundance and trends of selected species or groups	3.5	
		Consumers	F3	Freshwater Animals Disease & Pathogen	What is the incidence and level of disease in populations? Are diseases/pathogens affecting populations? What are trends in disease/pathogen?	visual surveys of possibly affected populations	disease types, occurrence, tissue samples, vectors	2.2	
		Population	F4	Amphidromous Fauna Size-Age Structure, Reproduction and Recruitment	Is variation within normal range, why not? What are selected short- and long-term trends? Is recruitment at normal levels?	Size & age structure: transects, plots. Repro & recruit: downstream larval drift & upstream immigration.	abundance of size classes, recruitment and reproduction rates, species diversity	2.1	
			F5	Established Alien Species - Predatory Freshwater (vertebrate and invertebrate)	What is the extent of present infestations? What is the impact of predatory invasive species on native species abundance and distribution? What are effective management strategies for invasive species removal?	Periodic sampling of freshwater habitats.	abundance, Distribution	2.9	
			F6	Alien Incipient Invasives - Predatory Freshwater (vertebrate and invertebrate)	Is species present, if so what is the nature and extent of infestation? What are the most effective strategies for detecting and preventing new invasives species? Where should efforts be focused? What are potential impacts?	Periodic sampling of freshwater habitats outside of parks	abundance, Distribution	2.8	

Intro, Monitoring goals & objectives, Conceptual Models, and Vital Signs

Also use main handout of review materials (http://www.nature.nps.gov/im/units/pacn/monitoring/plan/vs04/review_materials.htm)

Ecological Characteristic	Vital Sign Category		Monitoring Objectives
Human activities & cultural practices	Soundscapes		Monitor sound sources, frequencies, occurrence, and levels
	Viewscapes / Lightscapes		Monitor landscape / seascape appearance Monitor light levels and characteristics of light/dark cycles
	Land Use		Monitor points of entry for invasive species Monitor water use adjacent to or upstream from park boundaries Monitor land use adjacent to, or upstream of, park boundaries
	Park Use & Activities		Monitor debris-trash occurrence in coastal, riparian, wetland, and lacustrine habitats; in or near high use areas Monitor patterns of park visitation, use & damage (terrestrial & marine) Monitor incidence & occurrence of bioprospecting
	Management Zones		Monitor levels of take & harvest of harvested species (marine, freshwater, and terrestrial) or resources (coral, sand) Monitor patterns and effects of use and management Monitor effects of management practices on wilderness character
			Monitor visibility Track rates of atmospheric deposition Track atmospheric concentrations of particulates and gases, levels of radiation--emphasizing those with known human health or environmental impacts Monitor core weather/climate conditions within each park (on each island) Monitor frequency and intensity (severity) of extreme events (hurricanes, waves, winds, rain, etc.) Identify and monitor spatial patterns of climate, such as trade-wind inversion elevation, lifting condensation level, lapse rates, etc.
Physical / Chemical Environment	Climate & Air Quality		Monitor physical ocean dynamics--ocean currents, sea level, tides/swell Monitor cycles of nutrients and elements within soils and water--including carbonate (oceanic), nitrogen, and phosphorous Monitor soil erosion Monitor soil quality trends (physical, toxics/contaminants, other biologic and nutrients) Monitor condition and extent of soil crusts Monitor trends in surface water flow regimes Monitor wetland (incl. anchialine ponds) water flow exchange dynamics, size, and distribution Monitor ground water flow rates and direction of movement (recharge)
	Soil, Water, & Nutrient Dynamics		Monitor water quality core parameters Monitor supplemental water quality parameters Monitor microbiological water quality parameters Monitor toxic and contaminant levels in water Monitor biological invertebrate communities
	Water Quality		Monitor surface volcanic activity (lava flows, eruption events & ground deformation) Monitor volcanic & non-volcanic seismicity Monitor extent, location, and causes of mass wasting events (e.g. landslides)
	Geology	Hazards	Monitor shoreline dynamics Track dune locations and topography Identify and monitor the extent of permafrost Monitor karst and non-karst cave and lava tube habitat characteristics, topography, and extent
		Landforms	
Biotic Integrity	Terrestrial Ecosystems	Vegetation	Monitor patterns of distribution & extent of community types Monitor fire regimes and effect on vegetation Track insect and disease presence during forest dieback
			Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
		Consumers	Monitor community dynamics, structure, function, and composition Monitor effects of management on native communities
			Monitor effects of biocontrol on native and invasive species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Cave Systems Community Monitor changes in cave communities
		Freshwater Ecosystems	Producers Monitor community composition, structure, and productivity
			Community Monitor community dynamics, structure, function, and composition
			Monitor disease incidence and impacts, especially on native species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
	Marine Ecosystems	Benthic	Landscape Monitor patterns of distribution & extent of community types
			Community Monitor community dynamics, structure, function, and composition
			Population Track community and population trends in harvested fisheries / collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
		Water column (motile)	Track community and population trends in harvested fisheries species Monitor disease incidence and impacts, especially on native species Monitor extent and response to treatment of established invasive species
			Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
			Monitor occurrence of non-established (incipient) invasive species
			Community Monitor community dynamics, structure, function, and composition
			Track community and population trends in harvested fisheries collected species Monitor population size and distribution of native, endemic, or focal species, including response to restoration efforts. Where appropriate, measure demographics (size/age structure, reproduction, recruitment, etc.) of selected indicator species
		Intertidal	Monitor extent and response to treatment of established invasive species Monitor occurrence of non-established (incipient) invasive species